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SOME FACTORS INFLUENCING THE NUMBER OF MOLTS OF THE GERMAN ROACH

Lois Seamans and Laurence C. Woodruff*

In the pursuit of research problems, side issues often become evident which complicate the situation materially or which create such extreme interest that they absorb the main effort of the investigation. While not strictly true in the present instance, these observations were certainly incidental to the intended purpose of the project during which they were made.

It is a well known fact that many insects show a tendency to vary in the number of stadia undergone during the developmental period. The exact explanations of these phenomena are not well understood and seem to be accountable to a number of causes; perhaps the answer lies with the individual insect and is not to be found in studies of simple variables. In general, however, additional ecdyses seem to arise from adverse conditions of the enviroment. It has been the thesis of the junior author that growth problems in animals are mainly genetic in their nature but variable according to the effects of certain contributing extrinsic factors. Just what reconciliation can or need be made between this general idea and the facts of variable molting is a discussion beyond the limits of this paper.

While some kinds of roaches undergo more than a dozen stadia, those of the species involved here (**Blattella germanica** L.) normally molt six times in completing their growth, a fact substantiated by carefully observed developmental studies including many hundreds of life histories. Detailed records on molting have accumulated during the course of nutritional and growth experiments which while incidental to the main theme of the research are none the less interesting and have their bearing in establishing norms from which to judge variations. Naturally, extensive or consistent deviations attract attention and are worthy of mention if for no other reason than to show the value of the average condition.

During previous research of the junior author, extra molts had been observed frequently among the individuals of an experimental lot, provoking no very evident or striking conclusion except that they apparently occurred more commonly among those whose living conditions were not the optimum. In the process of growth studies involving the rate of regeneration of lost or experimentally amputated appendages (legs), evidence was compiled which indicated that such injury caused a frequent incidence of an added instar. Planned experiments have been launched to investigate further the exactness of this relationship but only those data which were acquired from

*Contribution from Department of Entomology, University of Kansas.

the aforementioned problem will be discussed at present.

The dictates of the growth rate experiments required that all individuals be fed an identical diet and otherwise handled in a standardized manner. The food, which previous tests had shown to be complete in a dietary sense, consisted of a finely ground mixture of 40% whole wheat flour, 40% dry skimmed milk, and 20% brewer's yeast. In so far as possible roaches emerging from the same capsule were divided into experimental and control groups, although not necessarily in equal numbers. Experimental animals were those from which one or two legs had been amputated. Forcible removal (appendotomy) was affected in such a manner as to sever the appendages at the articulation between the trochanter and the femur. The metathoracic leg was always selected for a single amputation, and in the cases of insects suffering double injury the mesothoracic leg of the same side of the body was also removed. All amputations were performed within 24 hours of eclosion. As development progressed molts were determined by measurements of the sclerotized parts of the body.

Of several hundred animals allotted to this series of experiments, 170 attained adulthood and all records were drawn from these for which full particulars were available. A total of 56 control roaches on which no injury was inflicted developed to maturity. All of these molted the normal number of six times. Development was at its best and the usual time required from egg to adult was around 50 to 60 days.

By no means did every individual undergoing an injury exhibit an extra molt, but among the experimental animals frequent instances of an additional stadium were encountered, leading to the suspicion of a definite connection between the two. Of 41 roaches which had a metathoracic leg removed, nine required seven stadia for complete development. Twenty-six molted seven times among the 73 which had both a mesothoracic and a metathoracic leg severed. Comparing these results with those of the uninjured controls where only the normal number of molts appeared, it is not difficult to conceive that the amputations inflicted upon the experimental animals have very definitely influenced the necessity of an additional growth period. There also appears to be a direct correlation between the incidence of the extra molt and the degree of the mutilation, approximately one-fourth of those which lost a single leg molting seven times as compared with over one-third of those undergoing a double injury. In no case however, were more than seven molts observed.

In another set of experiments consisting of feeding trials where the test groups were subjected to various types of deficient diets, an additional molt was also noted frequently, always among the experimental animals, while the controls receiving complete diets were normal in this respect.

Thus it would appear that adverse conditions of the enviroment tend to necessitate an extra stadium in the development of this insect which normally undergoes six molts. Minor deficiencies in the diet and injury each may produce such an effect. Possibly other factors will also prove to have a similar influence.

Two rather striking and decidedly interesting points are obvious in connection with this extra molt exhibited by the experimental animals. In the first place, the total size attained by a sclerotized part is slightly greater than is characteristic of the normal animal. This fact is shown clearly in the accompanying table where data for the metathoracic tibia, cranium, and pronotum are shown. In each

Measurements and growth ratios for roaches undergoing six and seven molts

Stadia	Average Measur'ment	Ratio	Stadia	Average Measur'ment	Ratio
		Metathoracic Tibia			
1	0.82	----	1	0.85	----
2	1.11	1.36	2	1.09	1.28
3	1.46	1.32	3	1.44	1.32
4	1.90	1.30	4	1.79	1.24
5	2.53	1.32	5	2.27	1.27
6	3.33	1.32	6	2.84	1.25
			7	3.60	1.27
Adult	4.67	1.40	Adult	5.00	1.39
		Cranium			
1	0.73	----	1	0.72	----
2	0.88	1.21	2	0.86	1.19
3	1.08	1.23	3	1.02	1.19
4	1.28	1.19	4	1.20	1.18
5	1.54	1.20	5	1.42	1.18
6	1.82	1.18	6	1.66	1.17
			7	1.90	1.14
Adult	1.98	1.09	Adult	2.09	1.09
		Pronotum			
1	0.99	----	1	0.97	----
2	1.34	1.35	2	1.27	1.31
3	1.77	1.32	3	1.63	1.28
4	2.23	1.26	4	2.02	1.24
5	2.78	1.25	5	2.44	1.21
6	3.47	1.25	6	3.04	1.25
			7	3.66	1.20
Adult	3.48	1.00	Adult	3.74	1.02

case, the definitive size is noticeably larger for the seven than for the six molt type of development. Secondly, the additional instar appears not to be merely appended to the six normal periods, but manifests itself early in the life of roaches which will undergo it, and is strikingly evident for the greater part of the developmental period. Somewhat confusing testimony as to its origin is displayed by the table

of average measurements and growth ratios. In the tibia, differentiation is clearly apparent for the first time only after the third molt, but in the cranium and pronotum it can be detected at least at the second or perhaps at the first ecdysis. In keeping with the added growth period, the progression factors for the seven molt type of development are naturally a little smaller and to some extent more uniform throughout their range.

SUMMARY

Blattella germanica normally undergoes six molts, but when subjected to a less nutritious diet or when minor injuries are inflicted, seven stadia may be required for complete development. Injuries in the form of leg amputations (appendotomy) appear to influence the incidence of the extra molt according to the degree of the injury. A greater proportion of individuals suffering a double amputation was forced into an extra stadium than was true where only a single injury was involved. The additional instar is not merely appended to the six normal periods, but becomes evident in the early growth, resulting in a lowered progression rate during the remaining life, and culminating in a slightly greater size of the sclerotized parts of the body.

MASS FLIGHTS OF THE PENTATOMID, THYANTA CUSTATOR (FABR.), IN KANSAS

Donald A. Wilbur, Kansas Agriculture Experiment Station

For the third successive year, mass flights of the common stink bug, **Thyanta custator** (Fabr.) have occurred somewhere in the Central States region. The most recent were the mass flights which took place during the evening of Oct. 14 and were reported in twelve localities representing ten counties in Kansas. These localities are as widely separated as Elkhart, in the extreme southwest corner of the state, and Hiawatha in the extreme northeast corner. The other localities are scattered along a direct line across the state between these two towns. It is remarkable that none of the localities from which records of the bug swarms were secured are farther than 20 miles off of this direct southwest-northeast line.

The two previously recorded swarms occurred at approximately the same time of year as the recent one. Severin[2] observed unusual swarms at Sioux Falls, S. D., on Oct. 5, 1936; and Ainslie[3] recorded immense swarms at Sioux City, Iowa, on Oct. 8 of the following year.

The recent flights attracted much local attention because they were observed by crowds that attended the high school football games held on Friday night. The football fields, each of which was brilliantly lighted by floodlights with from twelve to twenty-four 1500 watt lamps, attracted the bugs which soon settled over the field to the extreme annoyance of both spectators and players. The annoyance resulted not only from the presence of the insects, but also from their obnoxious odor. At Wilson and Sylvan Grove, the games had to be called off, while at other places the bugs caused the games to be temporarily interrupted, and resulted in the early departure of most of the spectators.

Records of the flights were secured for each of the following places (fig. 1) listed in the order of their location from the southwest to northeast; Elkhart, Morton Co.; Dodge City, Ford Co.; Larned and Rozel, Pawnee Co.; Hoisington, Barton Co.; Wilson, Ellsworth Co.; Sylvan Grove and Lincoln, Lincoln Co.; Minneapolis, Ottawa Co.; Clay Center, Clay Co.; Leonardville, Riley Co.; Hiawatha, Brown Co. The records were secured from the reports of the county agents,[4] from correspondents and from examining files of newspapers from all parts of the state. It is not known whether these flights

1 Contribution No. 464 from Department of Entomology

2 Severin, H. C.—Unusual abundance of **Thyanta custator** (Fabr.) in South Dakota. Jour. Econ. Entomology 30: (1) p. 210, 1937.

3 Ainslie, C. N.—Swarms of the Common Pentatomid, **Thyanta custator** (F.) in Iowa. Jour. Econ. Entomology 31: (1) p. 130, 1938.

4 The reports from the county agents were supplied by Dr. R. C. Smith and Dr E. G. Kelly.

resulted in an extensive migration or whether the insects originated in the locality in which they were observed swarming about the lights.

The characteristic features of the flights were their sudden appearance, their incredible numbers, the accompanying noise, the disagreeable odor, and their occurrence on one night only. The following excerpts or statements of observers indicate these characteristic features:

Wilson—"The bugs seemed to come from the north, struck buildings and piled up. One awning when let down had more than a bushel."

Dodge City—"Millions of insects swarmed this town on the night of Oct. 14."

Elkhart—"Traffic is said to have been stopped by the bugs."

Clay Center—The Topeka Daily Capital shows a picture of three men loading the bugs upon a truck in front of the business district in Clay Center. Two large truck loads of bugs were hauled away on the morning after the flight. The bugs appeared at about 8:00 p. m.

Minneapolis—The Minneapolis Messenger says that just about anyone to whom the invasion is mentioned replies that the bugs were thicker than he ever saw them before under any circumstances. It further reports that on the Ottawa County bank corner the bugs were piled up in a drift the next morning and had to be hauled away in a truck after the bugs had been killed by putting kerosene on piles of them.

Hoisington—The Hoisington Dispatch states that at the football field, when the swarms of bugs were the thickest, one could hardly see the players on the field. The bugs made a noise like many swarms of bees. At the close of the game they were piled five inches deep at the base of some of the flood light poles. In the oilfields north and northwest of Hoisington the bugs almost stopped drilling operations. They swarmed only the one night.

Leonardville—Mr. C. E. Moll, who officiated at the football game at Leonardville, supplied the following account of the Leonardville flight:

"At about 8:15 p. m. the bugs made their first appearance. Spectators were first made aware of their presence by the din caused by the whirring of wings. Many thought that a grasshopper invasion was coming. For several minutes the bugs milled about over the field and around the lights looking like snowflakes in a whirlwind. Presently some of the bugs began to come to the ground among the spectators. The band, located in the best lighted portion of the stands had to move immediately. The lights were reduced during most of period between halves and were completely turned off for a few moments. A portion of the bugs settled but started flying again as soon as the lights were switched on. It was necessary

to turn off the lights for a second and longer time before play could be resumed. For a while it was exceedingly doubtful whether the game could be completed."

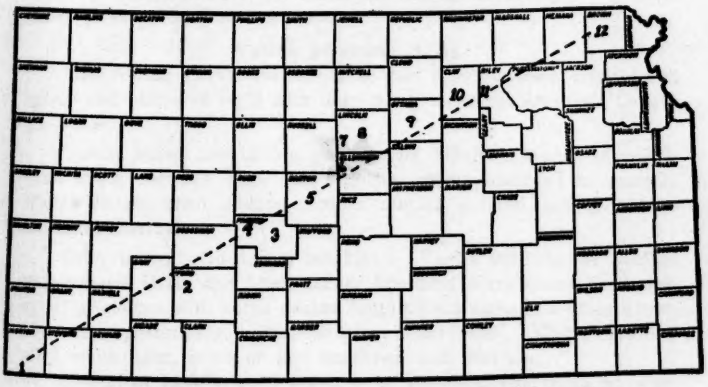
"The offensive stinkbug smell permeated the neighborhood, especially after spectators and players had crushed the bugs with their shoes and clothing. By the time the game was over, most of the bugs had settled to the ground under the light poles. The bugs were from 1½ to 3½ inches deep under one pole over an area of more than 450 sq. ft. There were not as many under any of the other seven poles."

The flight followed the warmest two-weeks period ever recorded in Kansas during the month of October. The night of the fourteenth was warm, clear and, in most places, quiet. Mr. S. D. Flora, meteorologist with the Weather Bureau at Topeka, Kansas, was consulted regarding the unusual invasion and requested to suggest any meteorological phenomena that might help to account for the southwest-northeast line distribution of the swarms. He replied as follows:

"The map for the morning of the 14th shows a decided area of high pressure in the far northwest with surface winds from the northwest as far south and east as North Platte and southerly winds

FIG 1

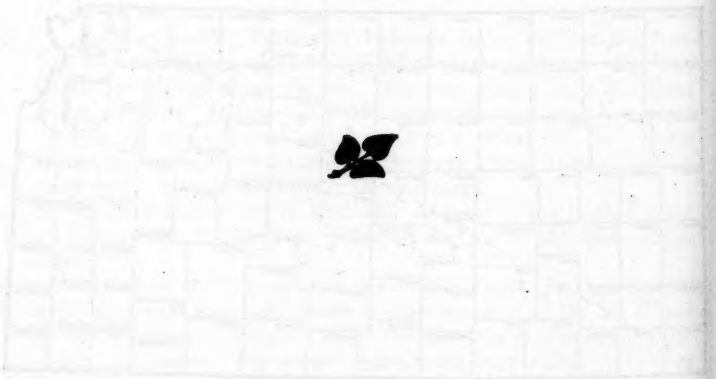
MAP OF KANSAS INDICATING THE TOWNS FROM WHICH RECORDS OF THE MASS FLIGHTS OF THYANTA CUSTATOR ON OCT. 14 WERE SECURED



1. Elkhart
2. Dodge City
3. Larned
4. Rozel
5. Hoisington
6. Wilson
7. Sylvan Grove
8. Lincoln
9. Minneapolis
10. Clay Center
11. Leonardville
12. Hiawatha

over Kansas. It is entirely possible that by the evening of the 14th, upper air currents were from the northwest north of a line drawn diagonally from the northeast corner of Kansas to the southwest corner of the state and that southerly winds prevailed southeast of that line. It might have been possible that this meeting of two air currents, a cooler current aloft from the northeast and a warmer current from the south beneath, caused the bugs to descend along the line you mention, from Hiawatha to Elkhart. We often find a rain area extending in this diagonal direction under conditions similar to this, though in this case no rain resulted."

Thyanta custator is the most common Pentatomid in Kansas, where it is abundant throughout the growing season, both in cultivated fields and in weedy patches. It overwinters as an adult and can be found early in the spring feeding on wheat. In Kansas, it has innumerable color grades, varying from a bright green with pinkish markings to brownish fuscous wih pale yellow markings. There were no indications of an unusual abundance of the bug prior to the flights.



THE GENUS CALANA DeL. (HOMOPTERA CICADELLIDAE)

R. H. Beamer, Lawrence Kansas*

The genus Calana was described by DeLong in Ohio Jr. Sci., Vol. 36, July, 1936, with the designation of "Thamnotettix umbricatus Ball' as genotype. This was evidently an error in spelling as the generic description fits **Thamnotettix umbratica** Ball and there is no such species known as **umbricatus** Ball.

In addition to the things set forth in the original description, this genus is characterized by a very large anal tube.

Calana umbratica (Ball)

Thamnotettix umbratica Ball, E. D. Can. Ent., p. 309, 1910

Numerous specimens of this species are at hand from many different localities in California. From this series it would seem that the unmarked specimens are most common.

Genitalia. Pygofer longer than wide, rounded at apex with large hook or spine near middle of dorsal margin and a smaller one at apex. Anal tube as long as pygofer, but not quite as wide; aedeagus in lateral view very broad, almost one-fourth as wide at base as length, curved dorsally, U-shaped with a pair of lateral, diverging processes one-fourth distance from tip, slightly longer than width of shaft at this point, ventral margin rapidly converging from base of processes to long slender apex on dorsal margin; styles wide at base, narrowed at middle to less than one-fourth basal width, slightly wider on outer half, apices rounded.

Calana bispinosa n. sp.

Resembling C. **umbratica** (Ball) but elytra almost truncate at apices and plates of male with deep notch on mesal margin. Length 3.5-4 mm.

Vertex sharp, less than a right angle, definitely longer at middle than width between eyes, disc slightly convex, rounded at margin. Elytra longer than abdomen, sides almost parallel, apices almost truncate, flaring.

Color tawny with darker markings. Vertex with darker median longitudinal vittae and often darker line next margin and bordering eyes; pronotum with three darker longitudinal stripes, median growing wider posteriorly, ending at tip of scutellum. Elytra hyaline, with veins light, more or less bordered with fuscous.

Genitalia: Last ventral segment of female about twice as wide as preceding, posterior margin slightly excavated with median third extended equal to lateral margin. Valve of male broadly triangular; plates narrower at base than valve, outer margin evenly rounded to inner; a deep cleft or notch on inner margin just beyond middle; pygofer longer than broad, outer margin rounded with two spines or

*Contribution from Department of Entomology, University of Kansas

hooks, one on outer dorsal margin and the other at apex under large dark blotch; style broad at base, narrowing to middle, gradually widening to broad knife-like apices; aedeagus long and narrow, in lateral view curved dorsally into a semicircle.

Holotype male, allotype female and eight pairs of paratypes, Irvine Park, Orange County, California, August 4, 1938, R. H. Beamer.

Types in Snow Entomological Collection, Lawrence, Kansas.

Calana rubralineata n. sp.

Resembling C. **umbratica** (Ball) but smaller, longitudinal line of vertex usually red and aedeagus of male quite slender in lateral view, forming almost a complete circle. Length 3.25-3.5 mm.

Vertex sharp, about a right angle, disc slightly convex; elytra longer than abdomen, apices rounded.

Color: semihyaline to tawny; vertex with ocelli usually dark and with a median longitudinal red line; pronotum usually with semblance of dark longitudinal vittae; elytra semihyaline with veins light, more or less bordered with fuscous.

Genitalia: Last ventral segment of female half as long again as preceding, posterior margin broadly and rather deeply excavated. Valve of male broadly angular, plates about as wide at base as valve, lateral margins converging to sharp apices, inner margins diverging on outer half. Pygofer longer than wide with rounded apex, no hooks or spines; anal tube longer than pygofer; styles very broad at base, gradually narrowed to about one-fourth basal width at middle, but slightly narrowed to tips, almost straight throughout and almost as long as plates; aedeagus in lateral view very long and slender, curved dorsally almost into a circle, with a pair of lateral processes slightly beyond middle, slightly less than half as long as half distance from their attachment to tip, shaft suddenly narrowing on ventral margin to about half its width just beyond processes.

Holotype male, allotype female and numerous paratypes, Monterey, California, August 22, 1935, R. H. Beamer; two males and twenty-nine females, Del Mar, California, June 2, 1935, P. W. Oman.

Types and paratypes in Snow Entomological Collection, Lawrence, Kansas; paratypes in U. S. National Museum, Washington, D. C.

The red mesal line of vertex is not present in some specimens, but a semblance of this red line can usually be detected.

THREE NEW DOLICHOPODIDAE[1]

F. C. Harmston and G. F. Knowlton[2]

The three species of flies here described as new were present in collections received from Professors H. E. Jaques of Iowa Wesleyan College and H. C. Severin of South Dakota State College.

Dolichopus facirecedens n. sp.

Male. Length 4.5 mm; of wing 3.8 mm. Front dark purple, slightly greenish near base of antennae; face moderately wide, covered with golden-brown pollen which is thinner at lower base of antennae, allowing greenish ground color to show through; lower one-fourth of face receding at approximately a 30° angle leaving the inner ventral margin of each eye sharply exposed; palpi dark velvety brown; antennae (fig. 4) yellow, third joint brownish on apical one-half; lateral and inferior orbital cilia wholly black.

Thorax dark green with purplish reflections; pleurae dulled with white pollen. Abdomen dark shining green with coppery reflections; hypopygium black, its lamellae (fig. 6) of moderate size, brownish with broad black border, scarcely jagged but with a deep apical cleft, fringed with long brownish hairs.

Front coxae yellow, slightly infuscated on outer basal margin and clothed on front surfact with dense, tiny black hairs; middle and hind coxae black with narrow yellow tips; femora yellow, middle and hind pair each with one preapical bristle, the latter ciliated near the middle of lower inner edge with about twelve long black hairs; front tibiae yellow, slightly infuscated on apical anterior margin; middle tibiae black except basal one-fourth yellow, and distal portion distinctly thickened; the bristles of both middle and hind tibiae strong; all tarsi black; fore pair with first joint as long as second plus third; middle basitarsi with one small bristle above and having two rows of small bristles on lower edge. Knobs of halteres and calypters yellow the latter with black cilia.

Wings (fig. 5) brownish; costa with elongate enlargement at tip of first vein; last section of fourth vein abruptly bent near its middle;; veins of wing noticeably infuscated; anal angle rounded, not prominent.

Female. Face wider than male; third antennal joint smaller; wings more uniformly brownish; hind femora not ciliated; posterior tibiae not thickened; middle basitarsi without bristle on upper surface; otherwise approximately as in the male..

Described from two males and two females.

Holotype, male, taken at Waubay, South Dakota, June 22, 1936, by H. C. Severin; allotype, female, taken at Martin, South Dakota,

[1]Contribution from the Department of Entomology, Utah Agricultural Experiment Station.

[2]Research assistant and research associate professor of entomology, respectively.

July 6, 1924, by H. C. Severin; paratype, male, taken in Dickinson County, Iowa, June 24, 1938 by B. G. Berger, and, one paratype, female, Dickinson County, Iowa, June 25, 1936, by D. Millspaugh.

Taxonomy. This species runs to **bruesi** V. D. in the Van Duzee and Curran keys (American Museum Novitates, numbers 683 and 684) from which it differs in many respects, such as: longer and narrower wings, antennae principally yellow, and possessing a deep cleft on apical margin of hypopygial lamella.

Dolichopus iowaensis n. sp

Male. Length 3.5 mm.; of wing 3 mm. Face moderately wide, sides nearly parallel, covered with ochre-yellow pollen; front dark bluish-green, very lightly dusted with golden pollen; antennae (fig. 2) black, third joint about three times as long as wide, acutely pointed at tip and densely pubescent with whitish hairs; arista about same length as third joint and arising from the dorsal surface near the apical fourth; lateral and inferior orbital cilia white, the black cilia descending about one-third the eye height.

Thorax dark green, dorsum and pleurae slightly dulled with white pollen. Abdomen dark green with narrow black incisures; base of first segment and lateral margins of others dulled with white pollen; hypopygium large, black; its lamellae (fig. 3) small, oval, whitish with a black border on apical margin, jagged and bristly, fringed above with pale hairs.

Fore coxae yellow with a brownish spot at base on outer side, front of fore coxae covered with minute, black hairs; middle coxae black with narrow yellow tips, their front surface covered with many delicate black hairs and slightly dusted with white pollen; hind coxae black with narrow yellow tips; femora yellow, middle and hind pair each with one preapical bristle, the latter without cilia below; fore and middle tibiae yellow; the fore tibiae with a yellowish-brown, hair-like bristle at apex on outer side which is nearly one-half the length of basitarus; hind tibiae yellow with black tip, very slightly thickened; fore tarsi about same length as their tibiae, first joint as long as the three following joints taken together; tip of first and second tarsal joints black, remaining joints entirely black; middle basitarsi yellow with apical portion infuscated, second joint yellow with black tip, remaining joints black; hind tarsi black, the first and second joints of nearly equal length. Calypters and halteres yellow, the former with black cilia.

Wings (fig. 1) grayish; costa with an enlargement at tip of first vein which tapers gradually toward apex of wing; last section of fourth vein slightly bent near middle.

Described from one male collected in Dickinson County, Iowa, June 24, 1938, by B. G. Berger.

Taxonomy. This species runs to **simulans** V. D. in the key to males of Nearctic **Dolichopus**, (American Museum Noviatate, No. 638)

from which it differs in: third antennal joint being more acutely pointed and pubsecent, surface of fore coxae clothed with black hairs, the middle and hind coxae black with narrow yellow tips, palpi black and face covered with ochre-yellow pollen, and having the costal margin of wing much less thickened.

Argyra dakotensis n. sp.

Male. Length 3 mm., of wing 3mm. Face and front silvery white; palpi brownish, velvety; proboscis black with brownish hairs; antennae (fig. 7) black; first joint long, hairy above; third nearly three times as long as wide, obtusely pointed; arista but slightly longer than third joint. Lateral and inferior orbital cilia white.

Dorsum of thorax shining green, slightly dulled with white pollen, scutellum with four marginal bristles, without hair on its disk; pleurae darker, thickly coated with white pollen. Abdomen shining green; a large yellow spot on the sides of the first, second, third and fourth segments, a less clearly defined spot on the fifth segment; the yellow of the abdomen leaves narrow anterior, posterior and median dark green lines; abdominal hair entirely black. Hypopygium small, black, its outer lamellae brownish, rounded at tip; inner appendages yellowish-brown, rounded at tip.

Coxae yellow; hairs and bristles of fore coxae whitish; anterior surface of middle coxae with dense black hairs; a single black bristle on outer surface of hind coxae.

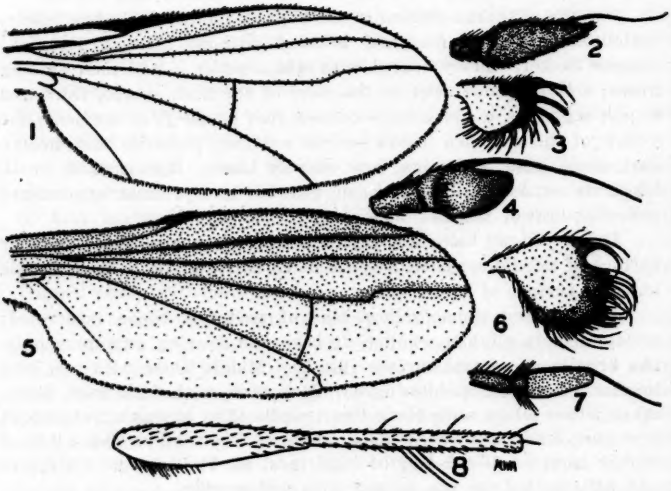
Femora and tibiae yellow, tips of posterior tibiae infuscated; middle femora slightly swollen at base and bearing numerous hair-like bristles on ventral surface (fig. 8). Middle tibiae with two long bristles near their middle (fig. 8). Fore tarsi with fifth joint black, other joints yellow with black tips; middle tarsi blackish from tip of first jont; hind tarsi wholly black; joints of fore tarsi as 13-5-4-3-2; of middle tarsi as 16-6-5-4-3; of hind tarsi as 11-10-6-5-4. Calypters and halteres yellow, the former with yellow cilia.

Wings grayish; third vein slightly bent backward at tip; fourth vein nearly parallel with third, last section of fifth vein slightly more than twice as long as the cross-vein.

Described from one male taken by H. C. Severin at Pineridge, South Dakota, July 8, 1924.

Taxonomy: This species runs to **calceata** Lw. in the Van Duzee key to Argyra males, (U. S. Nat. Museum. Proc. 66, No. 23.) but differs in being smaller, lacking black bristles on anterior coxae, longer and less pointed antennae, darker tarsi, and in possessing two long prominent bristles on outer surface of middle tibiae.

Type in collection of Utah Agricultural Experiment Station.



Dolichopus iowaensis n. sp. 1-3; D. facirecedens n. sp. 4-6; Argyra dakotensis n. sp. 7-8.

SOME NOTES ON THE NESTING HABITS OF BATAZONUS NAVUS CRESSON*

Robert E. Bugbee, College of Emporia, Emporia, Kansas

OBSERVATIONS ON B. NAVUS

A number of these wasps were observed along the north shore of Reading State Lake, Lyon County, Kansas. It was late in September of 1938, and they were burying their spiders in a sun baked clay and dirt mixture which earlier in the summer had been under several inches of water. The former shoreward edge of the lake was marked by a stand of short weeds interspersed with tall bunches of blue stem grass.

My attention was first attracted to them by the discovery of the lifeless body of a spider (probably **Argiope trifasciata**) lying across a bent weed stem. Later several specimens of **Argiope aurantia** were also found. Both these spiders seem to be common in this vicinity in the fall where they spin their circular webs among the blue stem grass and low bushes and take a heavy toll of grasshoppers. **Batazonus navus** did not prey upon the large fullgrown spiders but chose only half-grown individuals.

Like some other species of the spider hunting wasps **B. navus** secured her prey first before locating her nesting site. The spiders were dragged to the spot along the lake shore and left some six to eight inches from the digging operations. The actual nesting site was sometimes a bare patch of ground under cover of low, scattered weeds and at other times in bare areas with no sheltering vegetation whatsoever. In several cases the spiders were left, during the digging operations, balanced across some bent or fallen grass stem an inch or so above the ground. At other times, however, the limp bodies were simply left on the ground. Peckham (1898) records similar actions for **Episyron quinquenotatus** (**Pompilus quinquenotatus** of Peckham) which either placed their spiders in the crotch of a nearby plant or left them on the ground. With the spiders located one way or the other the wasps along the lake shore commenced to dig and in a few minutes had holes opened in the earth the diameter of a common lead pencil. They frantically removed small pellets of earth with their mandibles and dropped them at the edge of the holes. In all cases observed the wasps faced westward during the whole process of digging, and the collection of removed debris thus stretched eastward behind them. As the holes grew deeper, they would plunge in head first and then back out again quickly, dropping their pellets of earth. From time to time they would pause long enough to sweep the dirt, which accumulated too near the edges of the burrows, backwards and under them with their front legs, walking

*Kindly identified by Mr. Nathan Banks, Museum of Comparative Zoology, Cambridge, Mass.

backwards as they did so. They might also dash over to the spiders and reconnoiter briefly and hurriedly, although several of the wasps completed their digging before the spiders were examined again. If the wasps were disturbed during the mining operations they would quickly retreat to the covering of the weeds and grass.

Eventually satisfied that their burrows were ready the wasps backed out and hurried to the spiders. Grasping them by the coxa of one of the legs they tugged them jerkily to the burrow openings. This time they backed down the holes and dragged their spiders over them. From underneath they manipulated them until they could grasp the tips of the abdomen. Slowly the spiders slipped out of sight with a jerky motion, the last to disappear into the darkness being the eight long legs which were forced together over their heads by the sides of the burrows. For perhaps four or five minutes nothing happened, then, movement in the holes showed the wasps were working their way out, head first, and they could be observed scraping loose dirt under them from the sides of the burrows . As soon as they emerged they brushed into the openings some of the loose soil from around the edges and then, backing down into the hole for about one-half of their length began a rapid up and down motion. During the course of this action they held the wings spread laterally as if about to take flight. At first this action was puzzling, but after several repetitions it became evident that they were thus tamping down the dirt. The motion was so fast that there literally hummed in my head the staccato hammerings of a riveting machine. The abdomen seemed to be curled ventrally and anteriorly so that the dorsal surface of the abdominal segments served as the tamper surface.

When the holes had been filled up flush with the surrounding surface, and the filler well packed down, they would pick up in their mandibles from nearby, small peebles and even twigs and scatter them about over the former entrance and environs. The camouflaging was so clever that once you had shifted your eyes you might never be sure that you had located the spot again.

All the observations were made late in the afternoon and often the sun had set and dusk was approaching before the wasps were finished. The feverish haste, characteristic of all their actions, seemed to be concentrated in a race against the coming of darkness. Their haste suggests the actions of **Episyron quinquenotatus** which was christened by the Peckhams (1898), the "Tornado wasp." They add, Never have we seen a creature so fiery, tempestuous, cyclonic." In all cases when **B. navus** had finished their burial they returned to the weeds nearby and, after cleaning themselves thoroughly, settled down among the leaves, apparently to rest and spend the night.

There may or may not be any significance in the fact that they seemed to limit their nesting activities to the late afternoon. On the

only morning trip that was made to the locality, no sign of the burrows or of the wasps could be found.

The whole procedure occupied on the average of from one-half to three-quarters of an hour.

Several of the nests were dug up. One went down into the earth at a gentle angle for about three and a half to four inches. The tunnel ended in a slightly enlarged chamber in which the spider rested. Another went straight down and was only two inches in depth. In this case the spider had not been placed in the enlarged chamber but had been left about mid-way in the tunnel.

A single small white egg was found attached to one side of the mid-ventral line on the abdomen of several of the paralyzed spiders.

DISCUSSION

The only references in the literature that I could locate which described anything similar to the rapid tamping action of **B. navus** was in **Wasp Studies Afield** by Phil and Nellie Rau (1918) and in **Instincts and Habits of Solitary Wasps** by G. W. and E. G. Peckham (1898). One of the species referred to by the Raus was **Pompiloides tropicus.** On page 54 their description read, "The abdomen was curled under the body, making the dorsal surface of the tip appear ventral; this convex portion, pressed against the ground, proved a very efficient sad-iron, smoothing and at the same time compressing the loose soil." Again on page 53, ... "packing the loose dirt back into the hole with all her legs and punching it down with the tip of her ventrally curved abdomen." This use of the abdomen as a trowel or smoothing instrument is explained even more clearly by Rau (1928, page 343) in his discussion of **Pseudagenia mellipes.** In all cases the descriptions do not seem to imply the rapid tamping action of **B. navus** but the use of the abdomen more as a tool for smoothing and compressing the dirt.

The Peckhams noted the use of the abdomen for several species of Pompilids including, **Pompilus fuscipennis, Psammochares scelestus (Pompilus scelestus** of Peckham), and **Episyron quinquenotatus.** Their description of **P. fuscipennis** (page 141-142) sounded more like the action of **B. navus** than any of the others. One particular specimen that they watched brushing some soil into its hole . . . "began to dance up and down upon it, jamming it into place with her abdomen." In addition to the tamping action she also used it to rub, . . ." like a pestle in a mortar, and as a brush to sweep away dirt." This triple action, however, was only observed in this one specimen of many of the same species observed by them at one time or another.

From the above it may be gathered that the abdomen is used as a tamping tool by many of the Pompilids and that there is considerable variation in the method employed. All the species mentioned apparently use it to some extent for pushing earth down into the

holes and may further smooth or tamp the earth down more firmly with it. However, only the description of **P. fuscipennis** seems to tally with the rapid tamping action observed in **B. navus.** Moreover the instinct must be more firmly implanted in the latter as the action was observed in all the specimens which were allowed to complete the closing of the nest before they were captured.

In summary the following may be stated.

1. **Batazonus navus,** like other Pompilids, secures its prey first before locating its nesting site and burying its spider.

2. It preys upon spiders of the genus **Argiope (A. trifasciata** and **A. aurantia).**

3. It may or may not leave the spider balanced across some weed or grass stem an inch or so above the ground while it digs the nest.

4. It uses its abdomen as a tool in closing the burrows for tamping down the earth but, unlike other Pompilids, the action is very rapid.

5. The instinct seems to be well implanted in **B. navus** for it occured in all the specimens observed.

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SOME OBSERVATIONS ON INSECT EDAPHOLOGY

W. G. Bruce, U. S. Department of Agriculture
Bureau of Entomology and Plant Quarantine

The plant ecologist (3) considers the following three environmental factors: Climatic, those which act upon the plant through the atmosphere; edaphic, those which operate through the soil; and biotic, those arising from the presence of other plants and animals.

In the study of insect ecology the entomologist has given most of his attention to two of these enviromental factors, namely, the climatic and the biotic.

Insect edaphology (entomo-edaphology) may be defined as the study of those enviromental factors affecting insects which operate through the soil. These edaphic factors include kind or type of soil topography, drainage, water content, hygroscopicity, air in the soil, vegetation, soil temperatures, soil solutes, etc.

A season may be too dry or too wet for the welfare of certain species of insects. It would be of interest to know whether such dryness or wetness is detrimental to the egg, larva, pupa, or adult, and to what extent climatic or edaphic factors are involved.

Experimentation and observation indicate that soil moisture is a determining factor in the scarcity or abundance of certain species of Diptera. Chapman and Cavitt (2) found that the percentage of soil moisture had a decided effect upon adult emergence of the pink bollworm **Pectinophora gossypiella** Saund. in both sandy-loam and clay-adobe soils. Commenting upon the influence of moisture on the larvae of **Lyperosia exigua** de Meij., Windred (5) writes, "Finally, there comes a point of dryness, as well as of wetness, where either the larvae cannot live or else they cannot pupate." Melvin and Bushland (4) state from their observations that as the moisture content of sand increased the emergence of **Cochliomyia americana** C. and P. adults was correspondingly reduced. It has been shown by the writer (1) that excessive soil moisture is detrimental to the development of **Hypoderma** pupae. Subsequent experiments with the pupae of horn flies (**Haematobia irritans** (L.)), screwworm flies (**Cochliomyia americana**), and houseflies (**Musca domestica** L.) indicate a similar relationship between soil moisture and pupal development.

For these tests 500 grams of air-dry fine sand was placed in each of a number of 1-pint, wide-mouth glass jars. A glass tube ½ inch in diameter and 5 inches long was placed upright in the sand at the center of the jar, and a metal lid having an aperture for the glass tube and two additional ¼-inch holes for the diffusion of air was fastened to each jar. One hundred pupae (50 pupae in the case of tests with horn flies) were buried ½ inch deep in the sand around the tube in each jar. The estimated amount of water needed to make up the desired percentage of soil moisture was added through the

glass tube. The total weight of each jar and its contents was recorded and the jar thereafter weighed daily, sufficient water being added each day to maintain the designated water content. The jars were kept in an insectary at a temperature of approximately 80° F. To check the moisture content at the conclusion of the experiment, soil samples from around the pupae in each jar were dried in an electric drying oven at 225° F. for 20 hours and the percentage of soil moisture determined.

The results of these tests are shown graphically in fig. 1.

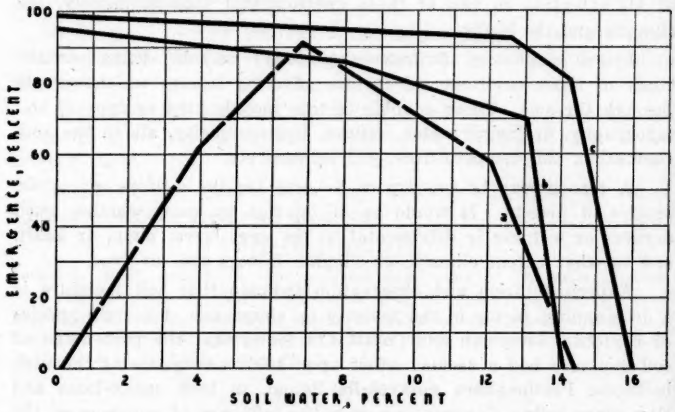

Fig. 1 Approximate curves showing relationship between soil moisture and adult emergence: a, **Haematobia irritans**; b, **Musca domestica**; c, **Cochliomyia americana.**

Twenty-three tests involving 2,300 pupae of **Cochliomyia americana** gave a high emergence of screwworm flies from soils containing less than 14 percent of water, and no flies emerged from soils containing in excess of 16.1 percent. The results of these tests verify frequent observations on the incidence of screwworms in Florida during the outbreak in 1935-36. These observations indicated that the moisture content of the soil had a direct influence on the relative abundance of these pests. During periods of heavy rainfall the screwworm infestations were most abundant in livestock on the high, well-drained soils and relatively scarce on the low, wet soils. Conversely, during the dry season screwworm cases were abundant on the low, poorly drained soils and comparatively scarce on the uplands. This may indicate that a dry soil, in nature, is a contributing factor in screwworm control even though the highest emergence in the laboratory was from pupae in a dry soil.

Sixteen tests with 1,600 pupae of **Musca domestica** gave results

similar to those obtained for **Cochliomyia americana.**

Seventeen tests with pupae of **Haematobia irritans** (50 in each jar) showed that soils containing less than 0.25 percent of moisture and soils of more than 14.5 percent inhibited the development of the pupae. The percentage of adult emergence was distinctly highest from soils containing approximately 7 percent of moisture. In nature, soil moisture has a definite effect upon the abundance of horn flies. It is common knowledge that horn flies are relatively scarce during periods of prolonged drought and that they increase in numbers rapidly after sufficient rainfall. The larvae, upon reaching maturity, pupate in the dung or in the soil, depending on which offers the more favorable moisture conditions. Ordinarily the larvae prefer to pupate in soil containing from 3.5 to 5 percent of moisture (by weight). Experience in raising thousands of horn flies under various conditions clearly demonstrates the susceptibility of horn fly pupae to unfavorable moisture conditions.

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(3) Holman, Richard M., and Robbins, Wilfred W. 1934. A textbook of general botany for colleges and universities. 600 pp., illus. New York.

(4) Melvin, Roy and Bushland, R. C. 1938. Effects of acidity, alkalinity, and moisture content of the soil on emergence of **Cochliomyia americana** C. and P. Jour. Econ. Ent. 31(5):611-613. October.

(5) Windred, G. L. 1933. Investigations on the buffalo fly, **Lyperosia exigua** de Meij. Part IV. The influence of moisture on the larvae of **Lyperosia exigua.** Council for Sci. and Indus. Research, Commonwealth of Australia, Pamphlet No. 43, pp 23-38.

SOME RECENT OBSERVATIONS ON THE ACTIVITIES OF PHYLLOPHAGA LANCEOLATA SAY (SCARABAEIDAE)*

Harry R. Bryson, Asst. Entomologist, Kansas Agricultural Experiment Station**

The wheat white grub **Phyllophaga lanceolata** Say always has been prominent as a pest of wheat in south central Kansas. Hayes[1] (1919) called attention to the fact that the local distribution of the species differs rather markedly in extent in the northern and southern parts of the state. He found the distribution limited to the lowlands in the southern part of the state while the species was found more frequently on the higher prairie lands in the northern part.

Recent dry years, 1935-1938, apparently, have had an effect in extending the range of this pest farther north. Although it is known to occur in every county in the eastern one half of the state from the southern boundary to the northern one, reports of injury to wheat usually come only from the south central counties.

During 1937, reports of damage were received from counties as far north as Cloud county. Adults were abundant in wheat fields in Osborne county during the summer of 1938. This increase in abundance is in evidence on the higher prairie land in the vicinity of Manhattan. So long as the species confined its activities to high prairie lands used for pasture or meadow, the injury to the grass roots was not so noticeable, but when it became abundant on golf courses its activities began to attract attention.

While collecting the beetles of this species for the study of their parasites, the writer became interested, in 1937, in the apparent increase in population of the beetles over numbers occurring on a golf course during previous years. The beetles were more abundant during 1938 which was an even number year, and the one when the main brood of the beetles emerge. Because no regular collection records have been kept regarding the population of the beetles on the area year after year, it was not until 1937 that the possible effect of this increased population upon the sod was given much consideration.

The turf on this golf course, like many similar courses in central Kansas is composed of various species of prairie grasses. In the fairways are found those species which have survived close clipping and exposure to tramping and to the hot sun. Many of the plants remaining have been weakened by this treatment to the point where they are barely able to maintain themselves. This injury to the plants, accentuated by the damage done by the feeding activities of

*Contribution No. 472, Department of Entomology.

**This paper embodies observations recorded under wheat insect investigations supported by funds from Project No. 8 Hatch.

[1]Hayes, Wm. P. The life cycle of **Lachnosterna lanceolata** Say. Jour. Econ. Ent. 12: 109-117. 1919.

the wheat white grub, has caused the sod to become broken so that weeds, especially dandelions, have become established. The dandelion plants, when subjected to constant clipping, assume a rosetted appearance and become so numerous that the surface of the soil is covered with a "mat" of leaves. Once these plants become established it is a difficult matter to eliminate them from the area as well as to reestablish the stand of grass.

The writer is of the opinion that the wheat white grub has been favored by these ecological conditions and has become a menace to the maintenance of the grass. The adult females, which are wingless, are forced to travel on foot wherever they go. This also supports the contention that the female beetles as well as the males were produced near where they are performing their various life activities.

Daily collections were made for a two weeks period during the summers of 1937 and 1938. Since this species is diurnal, collections were made in the fairways from 7:30 until 10:00 o'clock in the morning. As many as 339 beetles were collected during a single 2-hour period.

During this time of day, practically all the beetles, with few exceptions, were taken crawling about on the surface of the soil or on weeds which served as food plants. Two hundred eight of the 339 beetles collected were females. Observations indicated that the females were feeding consistently upon the leaves of the dandelion plants as well as upon those of other plants. At another time 400 beetles were collected near one green and one tee. Practically all of these were feeding upon the dense mat of dandelion leaves on this area. As many as 10-15 beetles were taken on one large rosetted plant.

As the temperature became higher during the morning, the beetles began to disappear from the surface of the fairways. While some of the beetles crawled into the rough others burrowed into the soil. Where dandelions were plentiful and where the females had been feeding upon the plants, they were observed to burrow in the soil directly beneath a single dandelion plant, covering an area 10 inches in diameter.

A few eggs were found at a depth of four inches but due to the fact that holes had to be dug in the fairways, it was not feasible to excavate to determine the number of eggs deposited on the areas. No excavations have been made to determine the population of the larvae present in the fairways with that to be found in the rough. Frequent examinations of the females collected each day showed that each female contained from 11 to 26 eggs. Since many pairs were observed in copula, the writer has every reason to believe that the females were depositing eggs on the area. Females retained in the insectary deposited fertile eggs which hatched. Both males and females were parasitized by Sarcophagid flies. Species of the flies

reared have not been determined. This parasitism may aid in reducing the number of larvae remaining to injure the sod.

SUMMARY

The foregoing observations indicate that the wheat white grub possesses potentialities as a pest of golf courses in Central Kansas. A cycle of ecological conditions may result in the perpetuation of the species on the areas and the grass may be greatly injured by its presence.

The larvae and close clipping tend to destroy the grass on the fairways. Dandelions grow on the denuded spots and furnish food for the females as well as a place under which they can burrow and deposit eggs to produce more larvae. The situation is one which will command careful consideration where the conservation of the turf has become a problem.

TWO NEW CORIXIDAE FROM BOLIVIA

H. B. Hungerford, Lawrence, Kansas*

Sigara femoridens

Size: Length 6.6 mm. Width across head 2.1 mm.

Color: General color slightly lighter than medium due to the fact that the pale bands of the pronotum and irregular figures of hemelytra are broader than the dark ones; the pronotum crossed by about ten brown bands, the median ones broken and overlapping. The brown figures of the hemelytra anastomosing to form a quite uniform reticulation. The base of clavus and the membranal suture slightly lighter in color. Head and limbs pale yellow, abdominal venter of males embrowned.

Structural Characteristics: Head of male approximately five-sevenths as long as pronotum, that of females less than half as long as pronotum. Face of male with broad oval depression not quite attaining inner angle of the eyes laterally. Pronotum faintly and hemelytra non-rastrate. Metaxyphus appearing a little longer than broad and bluntly pointed. The front leg of the male as shown in the drawing, the characteristic projection on the femur suggesting the name. The tarsal claws of the middle legs longer than the tarsi, which are shorter than the tibiae. The special features of male abdomen and genital capsule shown in the drawings.

Described from four males and two females from Cochabamba, Bolivia, South America.

Comparative Notes: This epecies resembles S. **denseconscripta** (Breddin) in the shape of the male pala but is distinguished from that species by possessing a blunt projection on front femur, by the shape of the right clasper, and by the pigment pattern, which is more reticulate than in S. **denseconscripta** (Breddin).

Sigara boliviensis n. sp.

Size: Length 6 mm. Width across head 1.95 mm.

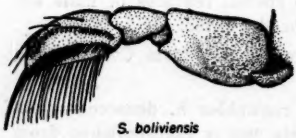
Color: General facies of usual color, the pronotum crossed by about eight dark bands which on the whole are slightly narrower than the pale stripes. Hemelytra with the dark figures more or less anastomosing into reticulations faintly transverse in character. Head and legs pale yellow; venter more or less dark.

Structural Characteristics: Head of male as measured from above shorter than interocular space, and about half length of pronotum. Face of male with oval depression not provided above with a distinctly edged arch. Pronotum rastrate, base of clavus faintly rastrate. Lateral lobe of pronotum a little broader than in S. **dita** Jaczewski. Metaxyphus as long as broad and bluntly rounded at apex. The front leg of the male as shown in the drawing. Tarsal

*Contribution from the Department of Entomology, University of Kansas.

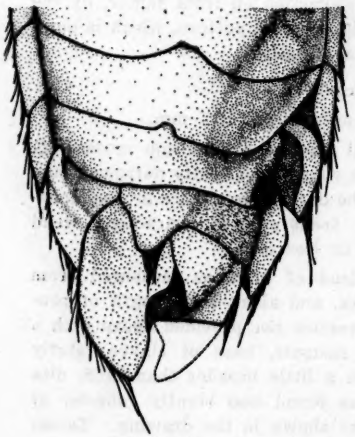
S. boliviensis

S. femoridens

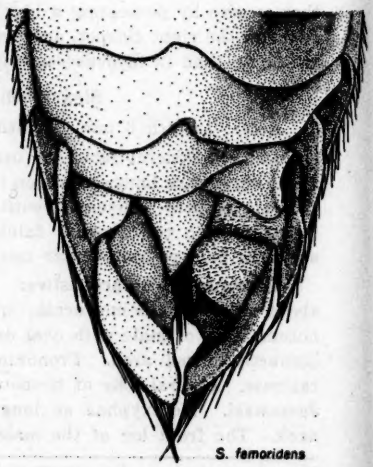


S. boliviensis

S. femoridens



S. boliviensis



S. femoridens

claws of middle leg as long as the tibia, which is longer than the tarsus.

The special features of male abdomen and genital capsule shown in the drawing.

Location of Type: Described from single male holotype in the Francis Huntington Snow Collections, University of Kansas. The specimen comes from Colomi, Bolivia, South America.

Comparative Notes: This species is very close to **S. dita** Jaczewski, the marked variability of which has been shown by Dr. Jaczewski. It is a larger species, with a relatively broad interocular space. The lateral lobe of the pronotum is relatively broader, the strigil larger, the underside of hind femur not so extensively clothed with pile, the light colored figures of pronotum and hemelytra larger, the frontal depression of the head not marked by a projecting arch, th median pronotal carina less marked, and the metaxyphus longer.

MINUTES OF THE 15TH ANNUAL MEETING
of the
KANSAS ENTOMOLOGICAL SOCIETY

University of Kansas, Lawrence, Kansas
APRIL 1, 1939

BUSINESS MEETING

President L. C. Woodruff called the meeting to order at 10:00 A. M. in Room 417, Snow Hall.

The minutes of the 14th annual meeting were read and approved.

REPORTS OF OFFICERS

The Secretary-Treasurer's report was read and approved, A summary of the report is as follows:

Receipts, April 1, 1938 to March 31, 1939	$ 571.74
Disbursements, April 1, 1938 to March 31, 1939	311.83
Balance	$ 259.91
Assets: U. S. Savings Bonds, Maturity value $850.00,	$ 637.50
Balance in checking account	259.91
Accounts receivable	None
Liabilities	None
Net Assets, March 31, 1939	$ 897.41

REPORT OF THE EDITOR OF THE JOURNAL

To date more than 200 articles have been printed in the Journal. Of this number, the subject matter was divided as follows:

Taxonomic papers	47 percent
Economic papers	28 percent
Insect Lists	12 percent
Insect Ecology	11 percent
Insect Physiology	1 percent
History of Entomology	1 percent

With regard to the origin of articles thus far printed in the Journal, the distribution was as follows:

Papers by members located at the Univ. of Kans.,	39 percent
Pepers by members located at Kans. State Col.,	28 percent
Papers by members outside the State of Kans.,	33 percent

Sixty-two percent of the present membership have received complete files of the Journal.

On the whole the Journal is fulfilling its purpose, but there should be an improvement in the format of the Journal and a reduction in the price of reprints.

Editor's report was accepted.

Dr. Lawson moved that the Secretary be authorized to proceed with making new publishing arrangements for the Journal, beginning with the July, 1939 number.

Motion seconded and passed.

Dr. Lawson moved that hereafter the Journal be printed as follows:

The body of the text to be in 10-point type.

All keys, descriptions, footnotes to be in 8-point type, unless it be found advantageous to use 8-point leaded type throughout.

Motion seconded and passed.

Dr. Beamer moved that 25 separates be allowed to each author, provided that at least 25 additional separates are ordered; and further, that a price schedule for separates be set up by the Secretary to allow a sufficient profit to the Society to take care of running expenses.

Motion seconded and passed.

Dr. Parker moved that the Secretary be authorized to have printed approximately 50 extra copies of the Journal, over and above the regular subscription list.

Motion seconded and passed.

REPORT OF THE COMMITTEE ON WILD LIFE AND STATE PARKS

President Woodruff explained that inasmuch as the committee had been non-existent for some time, and that the Kansas Academy of Science has such a committee, it would seem proper to discontinue the Committee on Wild Life and State Parks.

Mr. Bryson moved that the Committee on Wild Life and State Parks be discontinued.

Motion seconded and passed.

APPOINTMENT OF COMMITTEES

President Woodruff appointed the following committees:

RESOLUTIONS: R. T. Cotton, D. B. Whelan, D. A. Wilbur.
NOMINATIONS: R. H. Beamer, R. H. Painter, W. T. Emery.
AUDITING: for 1939: B. E. Liston, M. W. Sanderson
AUDITING: for 1940: W. T. Emery, D. A. Wilbur.
OLD BUSINESS: None.
NEW BUSINESS: None.

Then followed the presentation of papers, the program consisting of 28 titles as follows:

Morning Session

1. Studies of some physical factors affecting the resistance of wheat to hessian fly attack. Elmer T. Jones, Bur. Ent. & Pl. Quar. Manhattan. (By title).

2. Some studies on the nesting habits of **Batazonus navus Cresson.** Robert E. Bugbee, College of Emporia.

3. The identification of the eggs of grasshoppers by the sculpturing on the chorion. J. B. Tuck, K. S. C.

4. Some additional grasshopper collection records. Roland W. Portman, K. S. C. (by title)

5. Recent notes on the activities of the beetles of **Phyllophaga lanceolata (Scarabaeidae)**. H. R. Bryson, K. S. C.

6. Road crickets. R. H. Beamer, U. of K.

7. A question of synonymy. H. B. Hungerford, U. of K.

8. Labels and labeling insects. R. H. Painter, K. S. C.

Afternoon Session

9. Observations on subterranean termites attacking living plants. F. L. McDonald, K. S. C.

10. Notes on the dusky plant bug (**Adelphocoris rapidus Say**) as an economic pest. Chas Curtis, K. S. C.

11. Preliminary observations of Crambus in Kansas. H. D. O. Miller, K. S. C.

12. Effects of high soil and air temperatures on some alfalfa insects. Roger C. Smith, K. S. C.

13. A method of utilizing pyrethrum for greenhouse fumigation. R. H. Beatie, U. of K.

14. A consideration of the white-fringed beetle as a potential pest in Kansas. L. S. Henderson, U. of K.

15. Observations on Ozark cave beetles. M. W. Sanderson, U. of Ark.

16. The biology of the black blister beetle (**Epicauta pennyslvanica Deg.**). Wm. R. Horsfall, U. of Ark. (by title).

17. A revisional study on new world **Plecia** and **Penthetria**. D. Elmo Hardy, U. of Kans.

18. Factors influencing extra molts in the roach. Max Temple, U. of Kans.

19. The genus **Aligia** (Homoptera). L. W. Hepner, U. of Kans.

20. The systematic value of genitalia in the genus **Ormenis** (Homoptera). Chas. L. Shepard, U. of Kans.

21. A new pest of junipers. Edw. G. Wegenek, U. of Kans.

22. **Rhopalocera**, distributional notes for southwestern United States. Wm. D. Field, U. of Kans.

23. Notes on the distribution of the genus **Trichocorixa**. R. I. Sailer, U. of Kans.

24. Insects notes of the hickory borer and redbud aphid. R. L. Parker, K. S. C.

25. Folklore of poisonous arthropods of Mexico. L. J. Lipovsky, U. of Kans.

26. Final report on the mosquitoes of Kansas. Mrs. Noblesse De Moss Hill. (by title).

27 Adjusting insect control conservation practices. Don B. Whelan, U. of Nebr.

28. The role of plastics in the field of entomology. Don B. Whelan, U. of Nebr.

FINAL BUSINESS

AUDITING COMMITTEE:

The treasurer's accounts for the period April 1, 1938 to March 31, 1939 have been audited this 1st day of April, 1939, and found to be in order.

(Signed): B. E. Liston, M.W. Sanderson

Motion made and seconded to accept the report of the auditing committee.

Motion carried

RESOLUTIONS COMMITTEE:

Whereas, the University of Kansas, the Kansas Academy of Science, and the Department of Entomology of the University of Kansas have all cooperated in making the meeting of this Society a success

Be it resolved that the thanks and appreciation of the Society be extended to the members of the local committee, Kansas University, and the Department of Entomology of the University of Kansas, for the excellent arrangements made for our comfort and for the facilities provided for holding these meetings.

Be it further resolved that the Kansas Entomological Society express their appreciation of the efforts of the Secretary-Treasurer during the past year in conducting the business of the Society and in the business management of the Journal., and furthermore, that the thanks of the Society be expressed to the Editor of the Journal for the excellent manner in which he has conducted this publication during the year.

(Signed): R. T. Cotton, D. B. Whelan, D. A. Wilbur.

Motion made, seconded, and carried to accept as a whole the report of the Resolutions committee.

NOMINATIONS COMMITTEE:

The committee placed in nomination the following members for officers for the coming year:

For President: R. T. Cotton
For Vice-president: R. L. Parker.
For Secretary-Treasurer: H. H. Walkden.

(Signed): R. H. Beamer, R. H. Painter, W. T. Emery.

Mr. Painter moved that the Secretary cast a unanimous vote for these officers. Motion seconded and passed.

It was voted that the Executive committee select the time and place of the next annual meeing.

Mr. Whelan suggested that the 1940 meeting be held in Topeka, Kansas, in lieu of meeting with the Kansas Academy of Science in Wichita, if, in the opinion of the Executive committee this is desirable.

Adjournment was at 5:00 P. M.

There were 65 members and friends in attendance, from Lawrence, Manhattan, Ottawa, McPherson, Emporia, Topeka and Coffeyville in Kansas, and from Fayetteville, Ark., Lincoln, Nebr., and Kansas City, Mo.

H. H. Walkden, Secretary-Treasurer.

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